

DYNAMICS IN INNOVATION NETWORKS

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ABSTRACT

Purpose of the paper and literature addressed: This study aims at providing new understanding on innovation network dynamics. This is accomplished by exploring how the dynamics manifest in networks for innovation. The empirical part studies the innovation process in five innovation networks from the partner search until the commercialization of a technical service solution or package.

Research method: The research employs a qualitative multiple case study. This study applies process research when studying the cases. Qualitative interviewing was used as the primary data collection method. The empirical data was analyzed with Event-based Network Process Analysis.

Research findings: The dynamic processes of entering included employment of new persons to the company, search for new partners, and establishment of new relationships. Repositioning manifested in making the development relationship dormant. Exiting manifested in exit and removal of actors. Factors that influenced network dynamics comprised changes in the organizational structure of the focal firm, new needs of customers, common interests of actors, lack of customer projects, and exit of the contact person. Critical events that led to network dynamics included change or removal of innovation project personnel, problems in innovation project management and planning, and financial problems.

Keywords: network dynamics; innovation; networks; process studies

INTRODUCTION

The increase in open innovation strategies has generated a need to know more about innovation process in networks (Johansson, 2012). The extant research describes innovation as a purposive process that starts when some actors have got resources to co-create something new, and they recognize that capitalizing this potential requires network interactions and time (Busquets, 2010). Current research emphasizes the role of innovation process in innovation project and product success (Froehle and Roth, 2007). Empirical findings have, at the same time, shown that innovation process faces high risks and barriers when innovations take place in networks (Dhanaraj and Parkhe, 2006; Enkel *et al.*, 2009; Lee *et al.*, 2009; Landsperger and Spieth, 2011). The extant research acknowledges that network dynamics can be a notable barrier in innovation (Pittaway *et al.*, 2004; Dhanaraj and Parkhe, 2006; Ritala *et al.*, 2012).

The current research, however, lacks knowledge on the innovation process in networks (Cantù *et al.*, 2012; Russo-Spena and Mele, 2012) which has also led to scant attention to dynamics in innovation networks. Instead, the focus has been on predictable elements in the innovation process (Essén, 2009). Innovation research has shown the importance of managing (Landsperger and Spieth, 2011) and orchestrating network dynamics (Dhanaraj and Parkhe, 2006; Ritala *et al.*, 2009; Busquets, 2010) but has very limitedly discussed how dynamics manifests in innovation networks.

This study aims at filling the gap in innovation network dynamics by focusing on the following research question: *How does the dynamics manifest in networks for innovation?* This is achieved by studying the innovation process in five innovation networks from the partner search until the commercialization of a technical service solution or package. The empirical data is analyzed with Event-based Network Process Analysis (Halinen *et al.*, 2013).

As the theoretical foundation of the research, this paper seeks insights from the IMP Group's research on network dynamics (Halinen *et al.*, 1999; Abrahamsen *et al.*, 2012; Johansson, 2012). It provides understanding on the phenomenon of dynamics in networks from the process perspective for this paper, and means to explore the phenomenon empirically.

This research contributes to innovation networks literature by providing new understanding on dynamics in innovation networks. The paper identifies different types of dynamics in innovation networks and shows how they manifest in the innovation process. This paper is structured as follows. The introduction is followed by the literature review. Next, the research method is described. After that the results of the empirical cases are discussed. The paper concludes with the discussion section.

LITERATURE REVIEW

Industrial network theory finds that analyzing of network dynamics is an essential part of network research (Olsen, 2012). A company belonging to a network needs to live with changes as it is linked to other actors through interconnected relationships and interdependencies. ARA model highlights the interplay between actor bonds, resource ties and activity links when analyzing the changing force in a network. Industrial network theory suggests that change is the result of a continuous networking process where actor bonds, activity links and resource ties are connected within the network (Halinen *et al.*, 1999) and repeatedly created and recreated (Abrahamsen and Håkansson, 2012). This kind of incremental evolution where the character of a relationship changes is regarded the main mode of network change (Halinen *et al.*, 1999). Networks face dynamics, for example, in

consequence of differences and conflicts between the actors (Abrahamsen and Håkansson, 2012). Also various external forces influence network change (Halinen *et al.*, 1999).

Change can take place at three different levels: actor level, dyad level and network level. Change may occur at the actor level within a company. Similarly change can take place at the dyad level in a relationship (Abrahamsen *et al.*, 2011). Single relationship dyads have a key role in the network dynamics in the industrial network theory, as change is an integral part of interaction between two actors that have actor bonds, activity links or resource ties (Halinen *et al.*, 1999). Change can further occur at the network level between connected relationships. In networks for innovation, a specific characteristic of dynamics is the change of roles and the increased temporality of relationships (Johansson, 2012).

The network approach sees that network relationships are connected and embedded in the network. The network is borderless by nature. Change may emerge in any part of the network and shift to some other parts (Halinen *et al.*, 1999). Change may appear at any point of time and it is a recurrent process as a consequence of interactions (Abrahamsen *et al.*, 2011). This phenomenon can be best revealed through the network approach. Relationships have important roles as the source and transmitter of change. In order to understand network dynamics, both direct and indirect relationships need to be considered (Halinen *et al.*, 1999).

Network dynamics may emerge due to different intertwined forces. The major force is the interdependence between actors, activities and resources. When actors with different intentions interact, tensions and forces of change may be activated. When the change is spread to other relationships, a network-level change will take place. Two types of changes can be found: incremental and radical. Incremental change refers to change in the character of relationships, and in radical change relationships are terminated or established (Halinen *et al.*, 1999).

METHODOLOGY

Research design and case descriptions

This research employed a qualitative multiple case study (Stake, 2008, 123) with five innovation projects that took place in networks. The qualitative case study research allowed studying both the innovation processes and their outcomes (Silverman, 2006, 349) within a real-life context (Scholz and Tietje, 2002, 9; Yin, 2009, 2). Case studies are typically conducted when exploring networks and relationships as they provide the means with which to develop a multidimensional perspective on the phenomenon in a specific context (Järvensivu and Törnroos, 2010). Qualitative case study research is employed in this thesis as it enables exploration of network dynamics by building understanding on the innovation processes together with various informants involved in innovation (Silverman, 2006, 349; Pratt, 2009).

This study applied the instrumental case study approach where particular cases provided an insight into the research question with the aim of forming general understanding of the phenomenon (Stake, 1995, 3). Generalizations made in the study are analytical, based on finding similarities within studied cases (Dubois and Araujo, 2007). Multiple cases enabled building more robust, generalizable, and parsimonious theory (Eisenhardt and Graebner, 2007). In this research, each case was chosen for theory-building reasons – that is, to illuminate the focal phenomenon and fill theoretical categories that enhance generalizability (Hallen and Eisenhardt, 2012). Therefore the study applied an abductive, theory development approach (Dubois and Gadde, 2002).

The abductive research process comprises constant iteration back and forth between the research steps (Eisenhardt, 1989). In abductive reasoning (Kovacs and Spens, 2005), abduction is based on matching, which refers to going back and forth between the theoretical framework, data sources, and analysis (Dubois and Gadde, 2002). Theory matching calls for seeking suitable theories to empirical observations (Kovacs and Spens, 2005). Iterations between and the final matching of the empirical and theoretical domains are characteristic of abduction (Dubois and Gibbert, 2010).

The empirical cases dealt with the development of innovative technical business-to-business service solutions and service packages (portfolios) in inter-organizational and intra-firm collaboration. Technical services were chosen for the study since they are typically delivered in cooperation with other goods and services providers and, as empirical research has shown, technical services firms are likely to engage in collaborative arrangements for innovation (Tether and Hipp, 2002).

The first case is about the resource management system development at Alfa, a construction, maintenance and professional services provider within energy, telecom and industry sectors. Alfa's aim was to be a pioneering and agile firm in its business field. This necessitated new kind of mindset in managing company resources. For this purpose Alfa decided to build a resource management system. With the help of the system Alfa wanted to develop and intensify the traditional way of performing work in the company. Six IT business solution firms formed a development network with the IT department of Alfa. The system was developed between 2008–2012.

Two cases deal with wind power service portfolio development, one at Alfa and the other at Delta, an engineering and consultancy firm. The peculiar characteristic of these cases is that they describe an emergent business field. Most of the actors were new in the field and many actors had been only lately founded. Alfa developed a modular service portfolio for the entire life-cycle of a wind turbine both in intra-organizational team and with customers, suppliers, consultants and university students between 2008–2012. Delta's aim was to provide large engineering and consulting service entities to the customers in the wind power field. Delta formed a development team inside the firm for this purpose in 2010. They hired also some university students for the development project. In 2012 Delta widened the cooperation to sister companies abroad.

The fourth case is about foundation solution development for wind turbine towers. The focal firm is a fastening technology firm serving customers around the world. Apart from manufacturing, the firm invests heavily in R&D functions. It made a strategic decision to start development work in wind power business in 2009. The representatives of the company had noticed that current wind turbine foundations could be substituted through a new foundation innovation that could be provided as a service concept to customers in the wind power field. They found Delta to innovate and design the foundation with them. Later Alfa joined the project as a pilot customer.

The fifth case is about new automation solutions in mechanical engineering industry. A technical trading firm Gamma wanted to help their customers improve their competitiveness through a new innovation, a robotics solution. They concluded a partnership with a robotics firm in 2009 to develop the solution. The robotics solution was launched in 2011. During the development process they got an invitation to tender from a large steelworks that needed a

comprehensive sample production solution. As the solution included various systems, Gamma and the robotics firm joined their forces with a laser-technology firm to offer the new to the world system to the customer. The sample production solution was taken in use in the spring 2013.

This study applied process research when studying the cases. Process research is able to describe how and why some temporally evolving phenomenon (Pettigrew, 1997; Bizzi and Langley, 2012) comes into being (Halinen *et al.*, 2012), develops and changes over time (Pettigrew, 1997). Process research enables exploration on the innovation process in networks. Time is always part of network research as the networks undergo constant change (Aaboen *et al.*, 2012). The meaning of events is constructed through their human connection to past, present and future events. This calls for human interpretations of events, on which the event-time network is socially constructed (Halinen *et al.*, 2012). In this study, innovation processes were followed both retrospectively and in real time (Bizzi and Langley, 2012). Data were thus collected by exploring what had happened and what was currently happening in the five innovation projects (Halinen and Törnroos, 2005).

Data collection

This research focuses on socially constructed reality (Gephart and Rynes, 2004, 454-455), which means documenting the phenomena from the perspective of the studied people (Silverman, 2006, 44, 56, 201). Qualitative interviewing was used as the primary data collection method (Warren, 2002). The interviews were conducted in the form of guided conversations (Yin, 2009, 106). Similar to a conversation, every interview was newly constructed. Each conversation was unique; the researcher matched the questions to the respondents' experience and expertise (Rubin and Rubin, 2005, 4, 12).

Qualitative interviewing can be employed to describe various events and processes. The interviewer seeks depth, detail, and richness in interviews, which is also termed "thick description" (Rubin and Rubin, 2005, 5, 13). Therefore, interviews were based on three kinds of question: main questions that guided the conversation, probes to clarify answers or request further examples, and follow-up questions that pursue the implications of answers to the main questions (Warren, 2002, 86-87).

The first round of interviews was conducted among the directors and project managers of the innovation projects at the focal firms Alfa, Delta and Gamma in January–September 2010. The second round of interviews was conducted among the directors and project managers of the three focal firms and firms that participated with them in the innovation networks. The second round of interviews took place in November 2011–December 2012 (see Table 1). Altogether 33 interviews were conducted in the five innovation projects. Interviews were audio recorded and transcribed verbatim.

Table 1: Interviews conducted in the companies collaborating for service innovation

<i>Case</i>	<i>Company</i>	<i>Position of the interviewee</i>	<i>Date of interview</i>	<i>Number of interviews per case</i> <i>Total n=33</i>
Resource management system	Construction, maintenance and professional services provider (Alfa)	Business development director/head project manager	15.2.2010 12.12.2011	6
	IT business solutions firm A	Business area director	28.2.2012	
	IT business solutions firm B	Project manager	25.1.2012	
	IT business solutions firm C	Project manager	13.1.2012	
	IT business solutions firm D	Project manager	16.1.2012	
Service portfolio for wind power industry at Alfa	Construction, maintenance and professional services provider (Alfa)	Business area director, wind power	19.2.2010 25.11.2011*) 11.12.2012*)	6
	Alfa	Sales manager	4.9.2012	
	Engineering firm B	Divisional director	24.1.2012	
	Wind power producer	CEO	24.1.2012*)	
Foundation solutions for wind turbine towers	Engineering firm A (Delta)	Project manager	20.9.2010*) 12.12.2011*)	6
	Technology firm	Business development and technology director	30.1.2012	
	Construction, maintenance and professional services provider (Alfa)	Business area director, wind power	19.2.2010*) 25.11.2011*) 11.12.2012*)	
Automation solutions for mechanical engineering industry	Technical trading firm (Gamma)	Group president CEO Business area director	11.2.2010 11.2.2010 20.8.2010 2.12.2011	9
	Robotics systems firm	Senior Vice President	16.12.2011	
	Robotics systems firm	Project manager	3.12.2012	
	Laser technology firm (later production systems firm)	Divisional director	1.2.2012 13.12.2012	
	Production systems firm	Project manager	1.2.2012	
Service portfolio for wind power industry at Delta	Engineering firm (Delta)	Unit director	30.1.2012	6
	Delta	Team coordinator	1.2.2012	
	Delta	Project manager	20.9.2010*) 12.12.2011*)	
	Delta	Wind power specialist	3.9.2012	
	Wind power producer	CEO	24.1.2012*)	

*) Same person interviewed for two projects in a single interview

Data analysis

The retrospective and real-time interviews with managers of various organizations that were directly involved in innovating projects, enabled the researcher to write down the innovation processes from the beginning into a point where the service solution or package was launched. This was followed by the data analysis. Preliminary research questions and the related literature provided the guidelines for the data analysis (Marshall and Rossman, 2006, 153, 156).

Event-based Network Process Analysis (Halinen *et al.*, 2013) was applied to analyze network dynamics in the five innovation projects. This approach is based on studying network processes that are defined as “comprising sequences of connected events and activities that unfold over time in an around networks” (Halinen *et al.*, 2013, 1214). An event-based analysis method approaches network dynamics from process perspective and captures reality through events rather than structures.

In network research, events are studied to make the change visible. Network actors provide definitions for events through their perceptions and interpretations. Events can take place at the company level, dyad, network or environment level. Company level events may comprise, e.g. changes in the organization structure, personnel or strategy. Dyad level changes may include, for example, acquiring or replacing a partner (Halinen *et al.*, 2013).

In data analysis, events were identified through retrospective and real-time analyses. Here the researcher moves back and forth repeatedly in time while analyzing the network process. Real-time analysis is applied to construct the process by following it forward, and retrospective analysis is used to reconstruct the process by tracking it backward. Further, an analytic scheme was used to reveal the dynamics involved in network processes. The scheme comprises three elements that assist in making sense of a process: influence factors, critical events, and the resulting changes. During the data analysis, attention was paid to reasons that made the events emerge and ways they influenced the business network. Then the three elements, stimuli that evoke the events’ materialization, events that give birth to change, and the changes are combined into an analytic framework (Halinen *et al.*, 2013).

RESULTS

Application of the event-based network process analysis provided means to find events that led to dynamics in innovation networks. Factors that made events emerge comprised changes in the organizational structure of the focal firm, needs of customers, common interests of actors, lack of customer projects, and exit of the contact person. Critical events included change or removal of innovation project personnel inside the company or in the partner firm, problems in innovation project management, failed innovation planning, and financial problems. Changes resulted in replacement of the principal supplier, employment of new persons to the company, search for a new partner, making the development relationship dormant, exit of one focal firm, and establishment of relationships to sister companies abroad. The following paragraphs describe these changes.

Changes in the organizational structures of the focal firms had notable influence on network process in innovation projects. Together with challenges in the innovation process, changes in the organizational structure could lead even to replacing the main supplier, as in the resource management system case. The resource management system development at Alpha was seriously affected by large organizational changes inside the company which led to replacing

the innovation project personnel with new ones. The business area director of the principal supplier explained: “When the project had been going on for about a year, almost all of the project people had changed at the customer side.” At the same time the innovation project management was not able to work properly because of varying views and unclear role division. This meant that new project personnel were not properly familiarized with the development project, and the project’s target was not clarified to them. This resulted in a project plan in which the principal supplier had listed a huge amount of development tasks. The principal supplier’s business area director stated: “The result was a wishing well that expanded the scope enormously ... And when the scope expanded, the budget also increased beyond all reason.” These events led to termination of the contract with the principal supplier and replacing it with a new one. Events that led to replacement of the principal supplier are shown in figure 1.

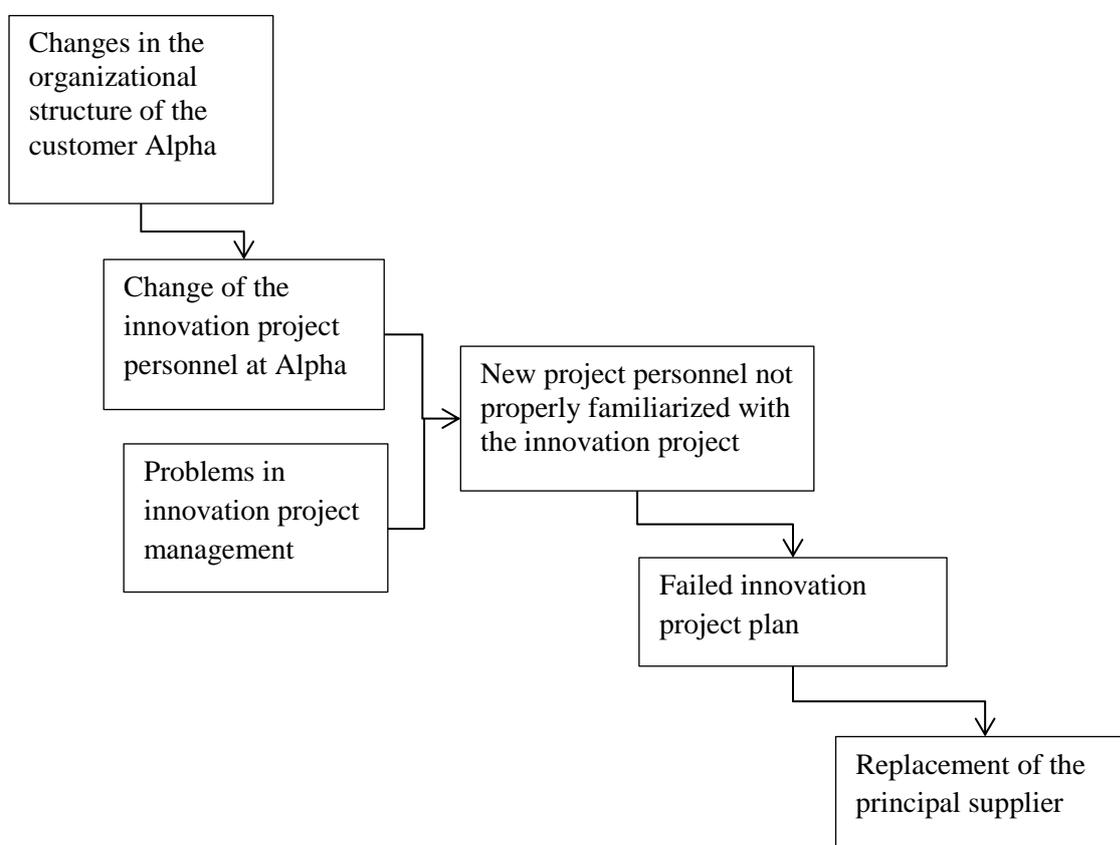


Figure 1. Events leading to replacement of the principal supplier

The massive organizational changes similarly affected the wind power service portfolio development at Alpha. The business area director explained this: “We had three levels in the wind power service portfolio development: a steering group, a project group, and employees who prepared process specifications. Those who prepared process specifications got new positions in the organization. Thus, they were torn away from this project.” As wind power business was very limited at Alpha at that time, the problem was to find new people who knew something concerning wind power. Only a couple of managers and employees remained longer in the wind power development team. Instead, Alpha got new motivated employees from the university students who had written their theses on wind power during

the development project. Events that led to employment of students to Alpha's wind power organization are shown in figure 2.

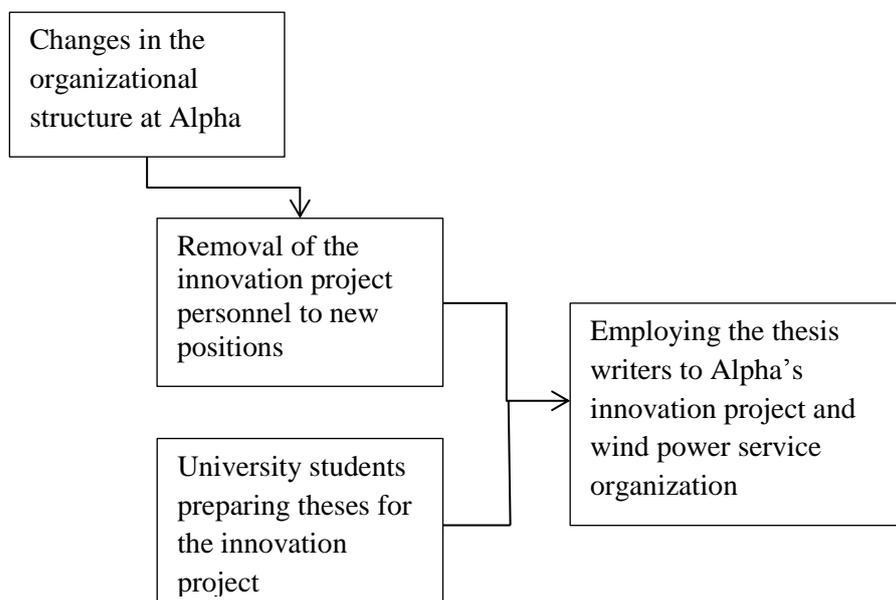


Figure 2. Events leading to employment of students into Alpha's wind power organization

Needs of the customers could also influence change in the innovation network. Alpha had not earlier offered any preliminary planning in the initial stage of the project. In many cases, the constructor of a wind power plant, however, could not apply for a building permit before an environmental impact assessment has been performed by a specialist firm. Therefore, Alpha needed to find a consultant with which it could offer preliminary planning. It had no previous relationships with consultants. Alpha then found an engineering and consultancy firm that already had some experience in performing EIAs. The consultant's divisional director found that the relationship with Alpha had specifically enabled them to reach a high level of learning. The divisional director put it this way: "These two projects that we've undertaken together have been the most challenging ones that can be found in Finland. We've reached a high level of learning because of these projects." But only a couple of years later, Alpha was again looking for a consultant partner. The business area director described how they were back at the beginning:

Their divisional director left the firm ... During the time I've been in contact with that consultant, people there have already changed four times. We don't have so much in common any more ... First, we see that here we could do something together, and then the people change. If that happens once, that's still alright, but four times!

Events that led to acquiring a partner for preliminary planning and termination of the relationship are shown in figure 3.

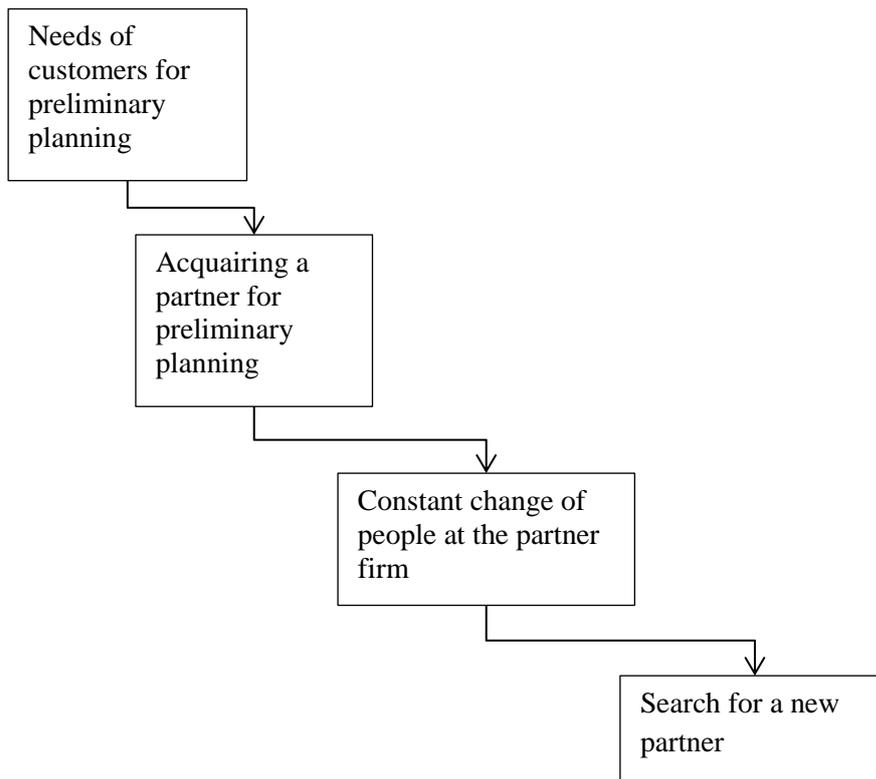


Figure 3. Events leading to acquiring a partner and relationship termination

Common interests could lead to establishment of a development relationship, whereas *lack of projects for testing of the innovation* and *exit of the contact person* could make the relationship dormant. During a wind turbine project, Alpha noticed that the foundation solution of the turbine supplier was outdated and complicated. Alpha wanted to find an alternative to the existing foundation. Alpha's business area director said: "I began to find out which firms could provide a more sophisticated foundation concept for the turbines." At the same time the fastening technology firm was looking for a wind turbine construction project in which they could test and further develop their first foundation prototype. The technology director of the fastening technology firm described the beginning of its relationship with Alpha as follows: "It was the result of our active search. We were searching for wind power firms that had been involved in this kind of business. And then we actively approached Alpha." The discussions between Alpha and the fastening technology firm led to the joint foundation solution development. This was the first time that the fastening technology firm had worked closely with the customer over the development process.

But later the turbine supplier had no more projects in Finland. This meant that the fastening technology firm and Alpha also had no cooperation. Alpha's business area director found that its relationship with the technology firm had been affected by the exit of the contact person and lack of construction projects: "The person with whom we cooperated at the technology firm has now left the firm ... We thought of continuing the development work when we get new foundation construction projects. Without a concrete project, the development work

doesn't pay." Events that led to establishment of the development relationship and making it later dormant are shown in figure 4.

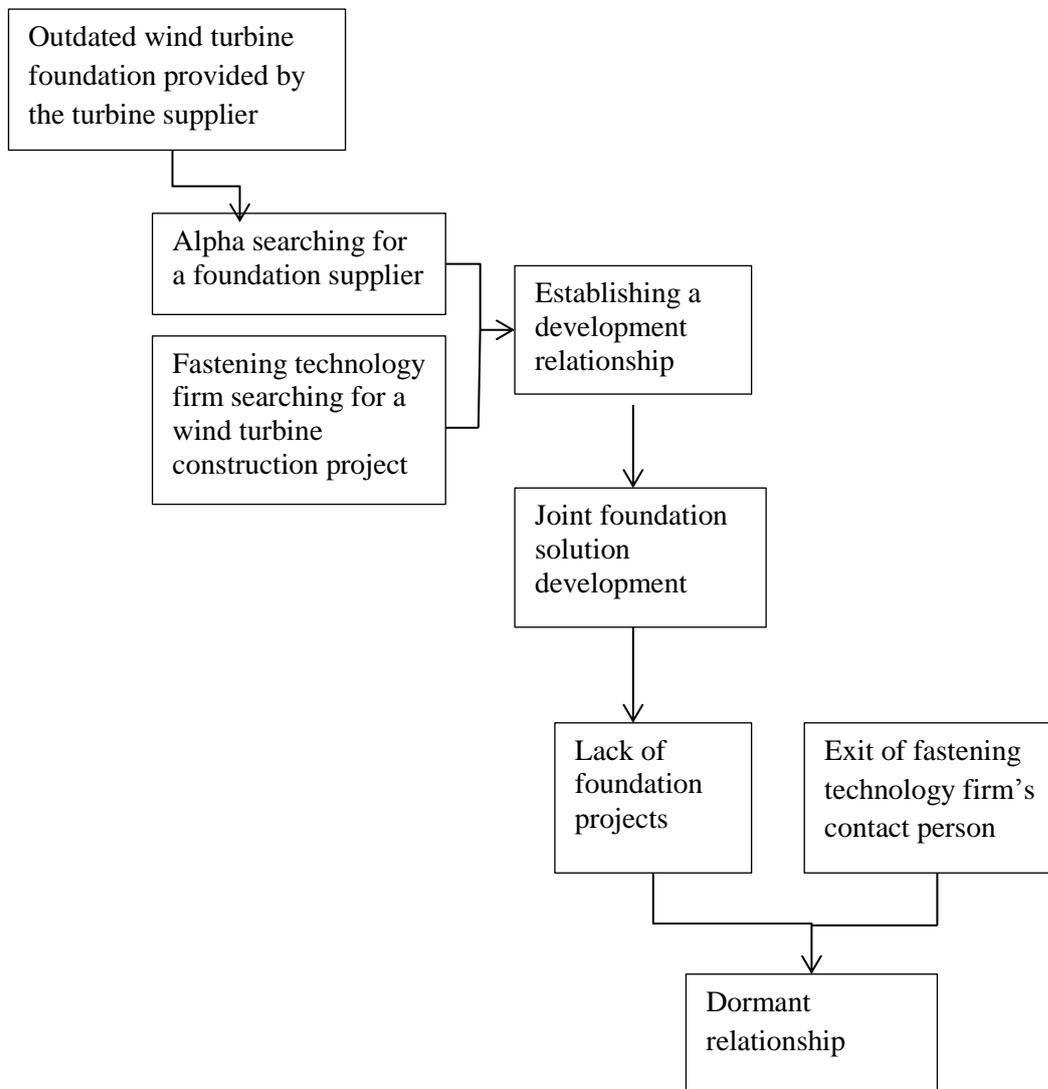


Figure 4. Events leading to establishment of development relationship and making it dormant

In 2010, the robot systems firm received an invitation to tender from a large foreign steelworks. They first thought they would offer their new robotics solution together with Gamma. The customer, however, wanted to purchase a turnkey that also included laser cutting, which Gamma and the robot systems firm could not provide. A Finnish laser technology firm had, some years earlier, delivered a modern laser cutting system to their reference customer's plant. The laser technology firm also wanted to offer a laser cutting system to the steelworks, but it needed a partner for machining. Gamma was contacted as it was known to the laser technology firm. Gamma then suggested that all three firms combine their resources and make a turnkey offer to the steelworks as required by the customer.

The laser technology firm, however, could not secure the guarantees. Their divisional director then thought of a production systems company. He knew what kinds of system this firm had made, and that it would be able to produce the laser cutting system if designed by the laser technology firm. The laser technology firm contacted the production systems company, and told them that they had a ready contract with a customer, and they now needed a partner that could take responsibility for the project towards the customer. The firms then formed a partnership.

The laser technology firm's project manager changed in the summer of 2011. This delayed the timetables to some extent, which led to delays in payments. In October 2011, the laser technology firm went bankrupt. There were three main suppliers remaining in the project. Events that led to establishment of the development relationships and exit of one actor are shown in figure 5.

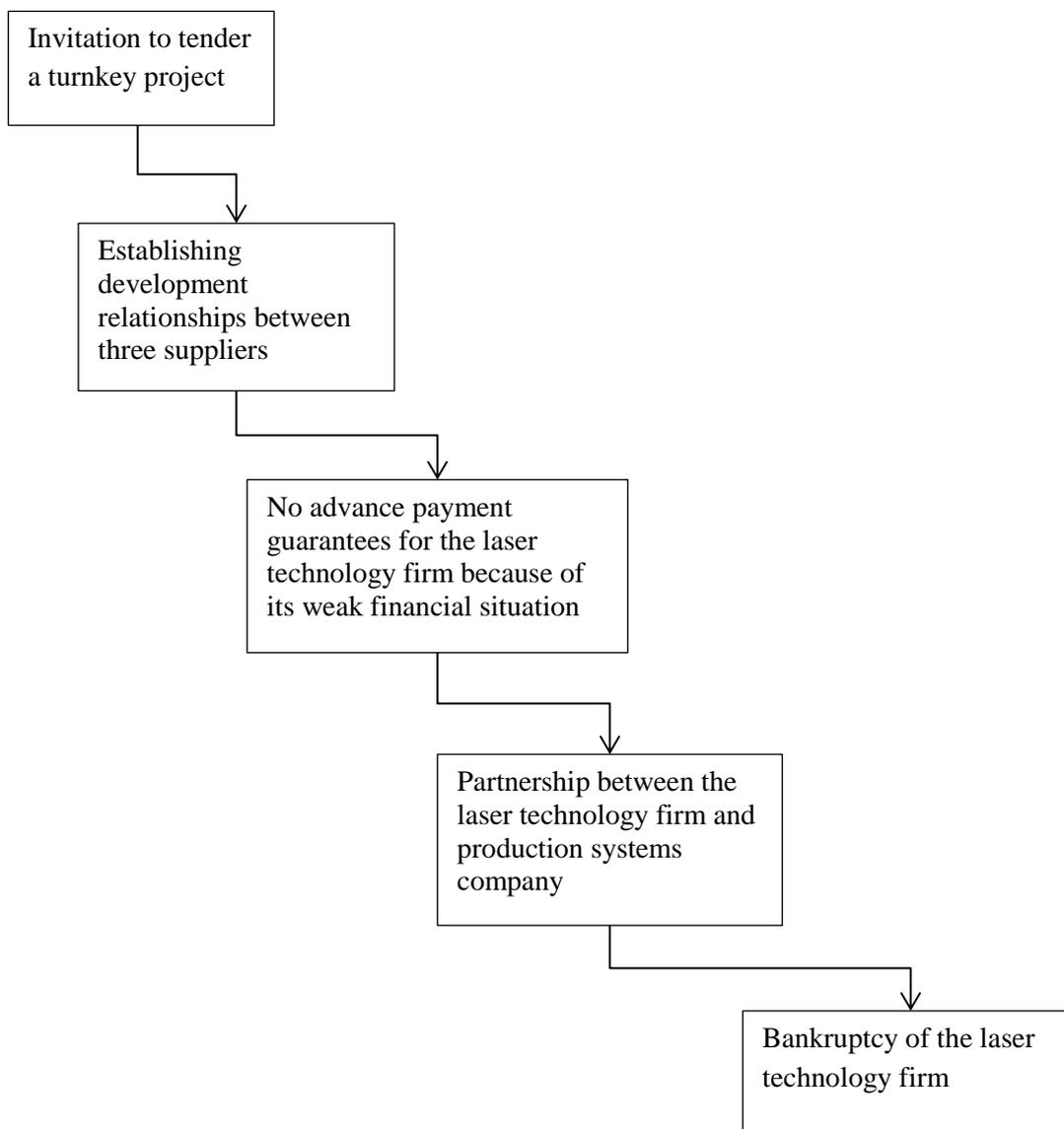


Figure 5. Events leading to establishment of development relationships and exit of one actor

Wind power services were an example of a market in which some of Delta's customers had recently begun to demand large entities. Delta's R&D management then decided to arrange a wind power workshop in the spring of 2010. The first wind power workshop concluded that an intra-organizational wind power team would be established after a new wind power coordinator had been nominated.

In the fall of 2010, the executive group contacted the director of the industry and energy sector and requested that he coordinate the wind power services development. All team members were involved only periodically in wind power projects, and they felt that they participated in the wind power team in addition to their everyday work. The team noted that their way of operating did not develop as they wished. The team coordinator expressed their challenges as follows: "For nearly two years, I've repeatedly said that we should pay attention to construction services, so that we could start marketing them ... But it hasn't progressed at all. The reason is that we all do this alongside our actual work." The team approached the senior management and proposed that the firm employ a wind power specialist and coordinator who would only concentrate on wind power business. In February 2012, Delta found a suitable person from a wind turbine company.

The wind power team expected the new coordinator to form relationships in other countries. The former team coordinator explained this idea: "It's no use reinventing everything here, if our sister companies mastered these things 20 years ago. We can get ready-made models from them." It soon became clear that the Nordic sister companies needed as much expertise from Finland as the Finnish firm needed from them. The phone calls from Finland seemed also to activate other companies. Together with their new partners in sister companies, the firms aimed to widen the wind power network to new countries, maybe even globally. Events that led to establishment of the development team, employment of a wind power specialist and establishment of relationships with sister companies are shown in figure 6.

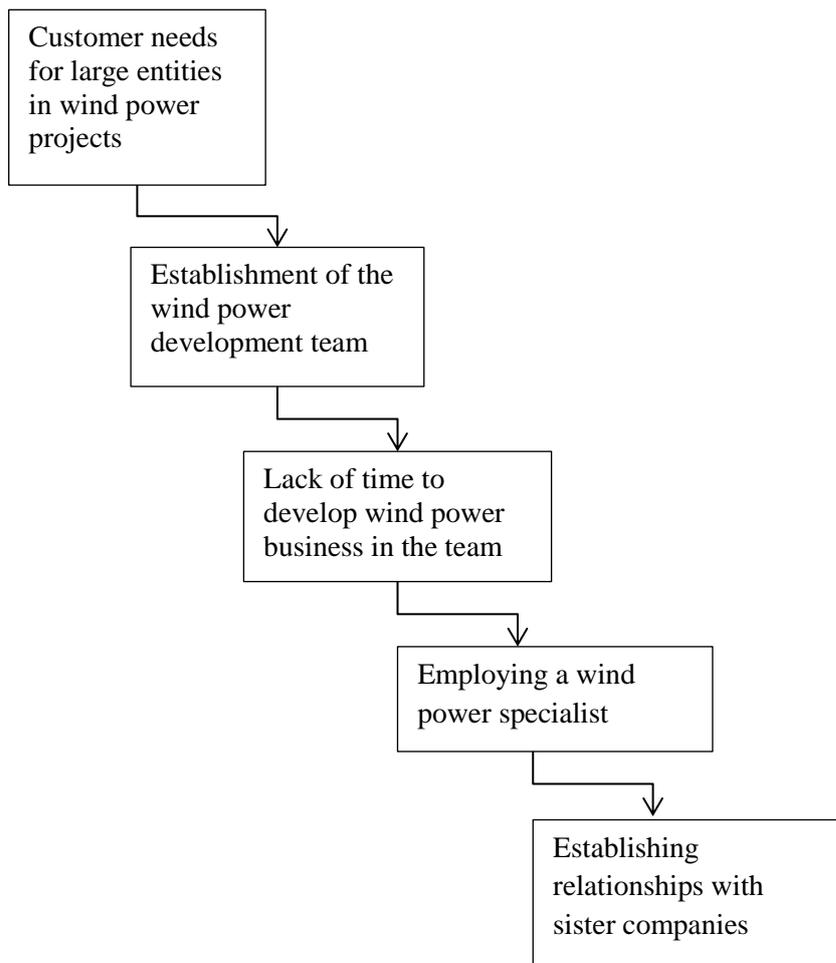


Figure 6. Events leading to establishment of development team, employment of a wind power specialist and establishment of relationships with sister companies

Thorelli (1986) found four distinct dynamic processes that characterize network membership: entry, positioning, repositioning, and exit. A single member entering, positioning, repositioning, or exiting from the network causes changes to the entirety. These processes could be revealed also from the innovation networks. Entering included employment of new persons to the company, search for a new partner, and establishment of relationships to sister companies abroad. Repositioning manifested in making the development relationship dormant. Exiting manifested in replacement of the principal supplier, and exit of one focal firm from the innovation network. Change could take place at the actor level within a company, the dyad level in a relationship or the network level between connected relationships as suggested by Abrahamsen et al. (2011).

Factors that influenced network dynamics comprised changes in the organizational structure of the focal firm, needs of customers, common interests of actors, lack of customer projects, and exit of the contact person. Critical events that led to network dynamics included change or removal of innovation project personnel inside the company or in the partner firm, problems in innovation project management, failed innovation planning, and financial problems.

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